
2002 IEEE International Geoscience and
Remote Sensing Symposium and the
24th Canadian Symposium
on Remote Sensing
REMOTE SENSING:
Integrating Our
View of the Planet
IGARSS
2002
IEEE
June 24-28, 2002
Toronto Canada

The Airborne Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR)

J.R. Piepmeier, P. Racette, W. Manning[1], J.R. Wang
NASA's Goddard Space Flight Center
Greenbelt, MD 20771
[1]Joint Center for Earth Systems Technology
Baltimore, MD 21250

Abstract **- Results of the first science flight of the airborne Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) for high-altitude observations from the NASA ER-2 is discussed. Imagery collected from the flight demonstrates CoSMIR's unique conical/cross-track imaging mode and provides comparison of CoSMIR measurements to those of the SSM/T-2 satellite radiometer.**

INTRODUCTION

The airborne Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) will provide measurements useful for atmospheric studies and satellite calibration and validation. Designed to match the tropospheric sounding channels of the Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave Imager/Sounder (SSMIS), the CoSMIR consists of four radiometers operating at 50-54 (3 channels - 50.3, 52.8, and 53.6), 91.655 (dual polarization), 150.0, and 183.31 (3 channels - ±1, ±3, and ±6.6) GHz. For a detailed description of the instrument see [1]. In February, 2002, CoSMIR successfully completed an engineering check flight and its first science flight on the NASA ER-2 high-altitude research aircraft. Imagery was collected using CoSMIR's unique combined conical and cross-track scan mode. Results from this flight are discussed below.

COSMIR IMAGERY

Demonstration of CoSMIR's unique combined conical/cross-track imaging mode can be seen in Fig. 1 for the 50.3 GHz channel. The top two maps contain the forward-conical and aft-conical images over and near the San Francisco Bay area of California; the Bay itself is located slightly above and left of the center of the map. The Pacific coast is seen in the top left portion of the map and the wetland areas contained within and near the San Luis National Wildlife Refuge are located in the lower right section of the maps. The increase in atmospheric path length is noticeable between the conical and cross-track images at 50.3 GHz, which is located near the molecular oxygen 60 GHz absorption complex. An increase in path length leads to an increase in molecular oxygen within the path. This increase produces the higher brightness temperature values seen in the conical-scan images, with incidence angles of 53.6°, compared to the cross-track image with incidence angles less than those of the conically scanned images.

A comparison between the three double-sideband CoSMIR and Special Sensor Microwave/Temperature-2 (SSM/T-2) channel frequencies centered on the 183.31 GHz water vapor band is shown in Fig. 2. The map area is located over the Pacific Ocean southwest of San Francsico. The aircraft flight line followed the sub-satellite track so the CoSMIR cross-track brightness temperatures near nadir (at the center of the swath) are comparable to the underlying cross-track SSM/T-2 brightness temperatures. Comparisons of the 183.31$\pm$1.0 GHz channels and the 183.31$\pm$3.0 GHz channels are shown in the top-left and middle-left images, respectively. Excellent agreement can be seen in the imagery. The bottom-left image is a comparison of the CoSMIR 183.31$\pm$6.6 GHz channel and the SSM/T-2 183.31$\pm$7.0 GHz channel. Precipitable water amounts increase along the descending flight line in the southwest direction. Observed brightness temperature differences at 183$\pm$6.6/7.0 GHz between the CoSMIR and the SSM/T-2 can be attributed to differences in the passband characteristics of the two instruments. The CoSMIR forward and aft viewing conical scans are shown in the middle and right column, respectively. The channel frequencies and color bars are applicable for the three images contained in each row. The small (+) symbols signify the center beam locations for the SSM/T-2 brightness temperature data.

This development was supported by the Defense Meteorological Satellite Program and the NASA Goddard Space Flight Center.